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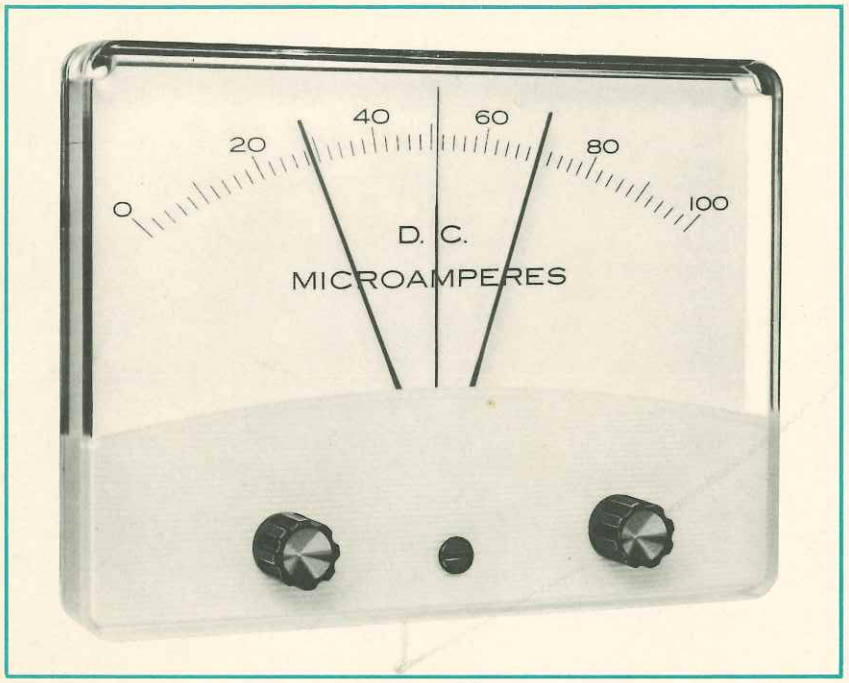
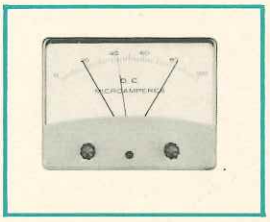
BULLETIN 33-D
JANUARY, 1965

Make light of control problems
with

API OPTICAL METER-RELAYS





contactless control with continuous indication through prismatic optics and solid-state electronics

api INSTRUMENTS CO.

A better kind of meter-relay—with simpler design for wider use, easier application, utmost reliability

Through prismatic optics and reliable solid-state electronics, API has developed a totally new type of meter-relay. This optical meter-relay provides continuous indication below, above, and at the control point itself. It is inherently fail-safe.

The API optical meter-relay has no moving parts except the measuring coil assembly. The light source and photoconductive cell are stationary.

High sensitivity with ruggedness

API optical meter-relays in the more sensitive ranges are standard with taut-band measuring movements. This movement is frictionless, has almost imperceptible hysteresis and, therefore, nearly perfect repeatability. It can be provided in other ranges at extra cost. Full scale sensitivities, are available to 5 μa or 5 mv. Based on these sensitivities, the meter-relay can provide control response to signal changes as small as 0.0125 μa or 0.0125 mv without amplification.

The taut-band movement is highly resistant to shock and is virtually indestructible in normal use.

Versatility in control

Four control forms are available: (1) On-off or limit, (2) Latching, (3) Time-proportioning, (4) Proportioning with SCR driver.

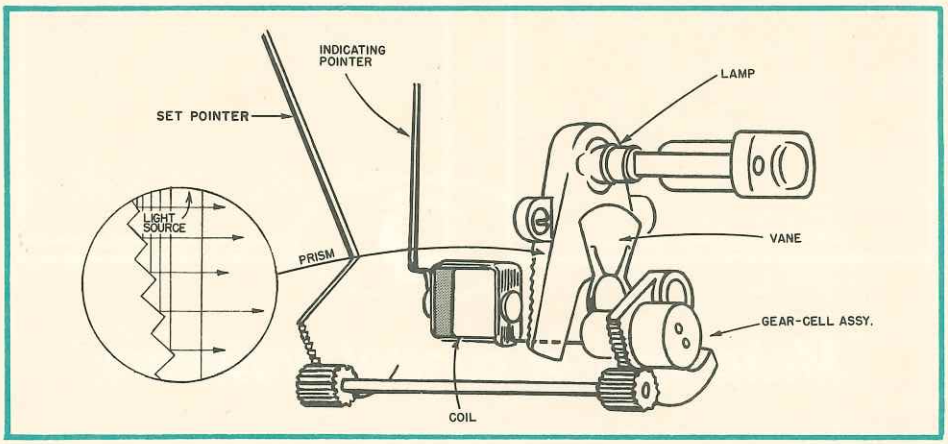
Optical meter-relays are available with one or two set-points.

Pyrometers with built-in compensation

Pyrometer models of the optical meter-relay have built-in electrical cold-junction compensation; no bimetals are used. A potentiometer in the control module provides adjustment for up to 10 ohms external lead resistance.

Two control packages

Only the measuring and position-detecting elements are within the meter housing. All other circuit components (including power supply, control circuitry, cold-junction compensation, load relay) are in separate control packages. Two control packages are offered.



One package is a complete, enclosed control module connected to the meter-relay by a single cable (standard length, 3 feet). All connections are made to a terminal block on the module so it can be located for greatest wiring convenience. A jumper between two terminals provides for latching of load relay when set-point is passed. This arrangement, requiring manual release, is generally used for limit alarms. Removal of the jumper provides automatic on-off control.

Load relays have Form C contacts rated at 5 amp at 115 volts or 2.5 amp at 230 volts, noninductive.

The second unit, called Control-Pak, includes a printed circuit board, load relays, and a transformer (all remotely mounted) with connecting cable. This Control-Pak offers greatest economy and flexibility of installation.

How it operates

The API optical meter-relay has five basic elements: (1) a d'Arsonval meter, (2) a light source that provides a uniform light field, (3) a photo-conductive cell, (4) a geared mechanism for positioning the cell assembly in relation to set-point adjustments, and (5) a vane, attached to the moving coil, which alters the amount of light reaching the cell.

In operation, light from a small lamp enters a V-shaped prism (clear methyl-methacrylate) mounted to a bracket on the meter mechanism. Light is transmitted longitudinally and is reflected at right angles when it strikes any one of the cut edges on the under side of the prism which serve as tiny mirrors.

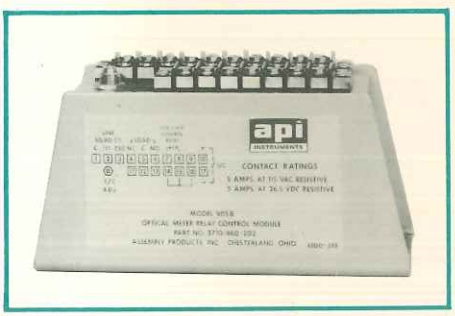
The vane acts as a shutter. When it is moved by the signal coil so that it comes between the prism and the photo-conductive cell, light is cut off and the resistance of the cell is high. This changed resistance is utilized in control circuits connected to the meter-relay, with an increase in resistance usually causing a load relay to drop out.

Conversely, when the vane rotates far enough to permit light to strike the cell, the cell's resistance is decreased and the load relay is usually triggered.

The differential between the low cell resistance (less than 10 kilohms) and high cell resistance (more than one megohm) is so steep that response time at set point is almost instantaneous—within 10 or 20 milliseconds.

In the area of set point, when the vane shuts off or permits only a fraction of the total available light, there is a true proportioning band, up to 5% of full scale, where cell resistance changes gradually.

A double set-point meter-relay is made by using two cells in a single gear assembly connected to the set-point knobs. The single lamp provides light to actuate both cells.

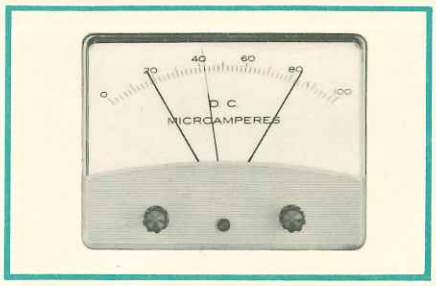


Control Module
(6 3/16"L x 3"W x 3 9/32"D max.)

Control-Pak
(P.C. board: 4 5/16"L x 2 1/2"W x 1"D max.)

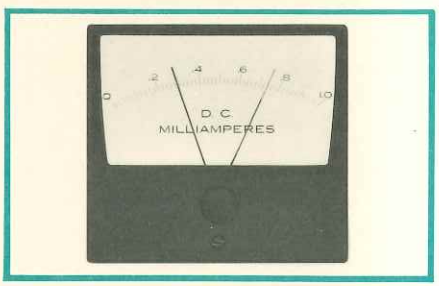
OPTICAL METER-RELAY MODELS

The optical meter-relay is part of API's new Stylist/ Panelist line of similar design, convertible-case meters. Thus, similarly styled panel meters and contacting meter-relays are available to give a consistent appearance.



302-L: 3¼", 502-L: 4½", 602-L: 5½" Panelist optical meter-relays with clear Plexiglas case have provision for color. Front-of-panel Panelist meter is converted to recessed-mounting Stylist (at right) by addition of die-cast Zamac bezel.

1302-L: 3½", 1502-L: 5", 1602-L: 6" Stylist models are recessed mounting, providing an uncluttered appearance with 33% of the meter behind panel. Set-point knobs extend through panel below bezel. Bezels are available in colors.

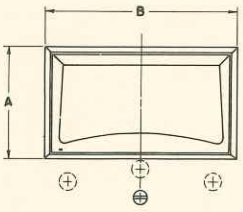


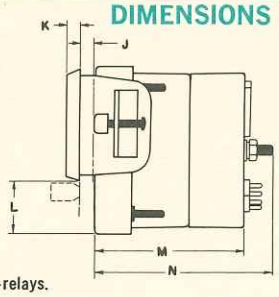
303-L: 3¼", 503-L: 4½", 603-L: 5½" Panelist optical meter-relays are available in three sizes with black phenolic case and glass window. These popular sizes may be used in many replacement applications without panel cutout change.

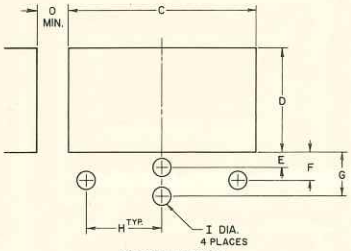
SPECIFICATIONS

Ranges	0-5 microamperes to 0-50 amperes, DC; minimum AC range, 0-10 microamperes. 0-5 millivolts to 0-500 volts, DC; minimum AC range, 0-250 millivolts.
Accuracy	Indicating accuracy ±2% of full scale, DC and ±3%, AC at normal room temperature. Available with thermistor compensation at extra charge to limit copper error to ±2% of full scale for ambient temperature changes from 0 to 140°F. Super-Calibrated optical meter-relays with scales individually calibrated and printed to match their individual movements are available in four classes. This extra cost service can produce meter-relays with tracking and accuracy each to ±0.5%.
Control Circuit	Load relay is rated at up to 2½ amperes at 220 volts or 5 amperes at 110 volts, resistive. SCR trigger output can fire all commonly used silicon controlled rectifiers.
Voltage and Frequency	The control module or Control-Pak which incorporates the power supply for the meter-relay operates on 110 volts, AC, 50/60 cycles. Circuit is insensitive to line voltage changes from 105 to 125 volts.
Control Settings	Control point is adjustable over full scale. Standard deadband is approximately 0.25% of full scale. Adjustable deadband available as optional feature.

DIMENSIONS



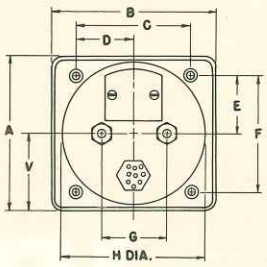


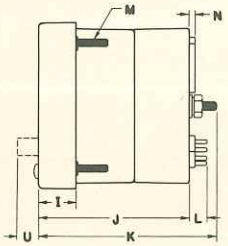


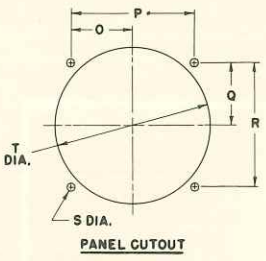
PANEL CUTOUT

Dimension "O" indicates minimum space between meter-relays.

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1302-L	2.02 MAX.	3.53 MAX.	3.34 +1/32 −.000	1.87 +1/32 −.000	.300 ±.005	.408 ±.005	.833 ±.005	1.193 ±.005	.312 ±.010	.250 MAX.	.250 ±1/64	.958 ±1/64	2.88 MAX.	3.52 MAX.	.95
1502-L	2.94 MAX.	5.02 MAX.	4.81 +1/32 −.000	2.78 +1/32 −.000	.260 ±.005	.488 ±.005	.760 ±.005	1.332 ±.005	.312 ±.010	.250 MAX.	.218 ±1/64	1.019 ±1/64	2.88 MAX.	3.52 MAX.	1.43
1602-L	3.39 MAX.	6.14 MAX.	5.86 +1/32 −.000	3.14 +1/32 −.000	.425 ±.005	.653 ±.005	.925 ±.005	1.332 ±.005	.312 ±.010	.250 MAX.	.250 ±1/64	1.173 ±1/64	2.88 MAX.	3.52 MAX.	1.43







PANEL CUTOUT

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
302-L	3.02 MAX.	3.16 MAX.	2.250 ±.005	1.125 ±.005	1.125 ±.005	2.250 ±.005	1.25 ±.010	2.79 MAX.	.69 MAX.	2.88 MAX.	3.52 MAX.	.37 MAX.	4-40 x .62 MAX.	.130 MAX.	1.125 ±.010	2.250 ±.005	1.125 ±.010	2.250 ±.005	.125 +.010 −.000	2.82 ±.010	.63 MAX.	1.51 MAX.
303-L	3.13 MAX.	3.28 MAX.	2.250 ±.005	1.125 ±.005	1.125 ±.005	2.250 ±.005	1.25 ±.010	2.79 MAX.	.75 MAX.	2.94 MAX.	3.57 MAX.	.37 MAX.	4-40 x .62 MAX.	.130 MAX.	1.125 ±.010	2.250 ±.005	1.125 ±.010	2.250 ±.005	.125 +.010 −.000	2.82 ±.010	.63 MAX.	1.56 MAX.
502-L	4.15 MAX.	4.60 MAX.	4.000 ±.005	2.000 ±.005	2.020 ±.005	3.560 ±.005	1.25 ±.010	2.79 MAX.	.69 MAX.	2.88 MAX.	3.52 MAX.	.37 MAX.	6-32 x .62 MAX.	.130 MAX.	2.000 ±.010	4.000 ±.005	2.020 ±.010	3.560 ±.005	.156 +.010 −.000	2.82 ±.010	.63 MAX.	1.83 MAX.
503-L	4.26 MAX.	4.71 MAX.	4.000 ±.005	2.000 ±.005	2.020 ±.005	3.560 ±.005	1.25 ±.010	2.79 MAX.	.76 MAX.	2.95 MAX.	3.58 MAX.	.37 MAX.	6-32 x .62 MAX.	.130 MAX.	2.000 ±.010	4.000 ±.005	2.020 ±.010	3.560 ±.005	.156 +.010 −.000	2.82 ±.010	.63 MAX.	1.89 MAX.
602-L	4.25 MAX.	5.62 MAX.	5.250 ±.005	2.625 ±.005	2.150 ±.005	3.000 ±.005	1.25 ±.010	2.79 MAX.	.69 MAX.	2.88 MAX.	3.52 MAX.	.37 MAX.	6-32 x .62 MAX.	.130 MAX.	2.625 ±.010	5.250 ±.005	2.150 ±.010	3.000 ±.005	.156 +.010 −.000	2.82 ±.010	.63 MAX.	1.64 MAX.
603-L	4.36 MAX.	5.75 MAX.	5.250 ±.005	2.625 ±.005	2.150 ±.005	3.000 ±.005	1.25 ±.010	2.79 MAX.	.76 MAX.	2.95 MAX.	3.58 MAX.	.37 MAX.	6-32 x .62 MAX.	.130 MAX.	2.625 ±.010	5.250 ±.005	2.150 ±.010	3.000 ±.005	.156 +.010 −.000	2.82 ±.010	.63 MAX.	1.69 MAX.

PRICES: OPTICAL METER-RELAYS

RANGES	OHMS*	MODEL PRICES FOR SINGLE SET-POINT (Add $15.00 for double)											
		502-L		503-L		602-L		603-L		1502-L		1602-L	
		DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC
MICROAMPERES													
0-500	175	$44.00	$48.00	$46.00	$50.00	$47.00	$51.00	$49.00	$53.00	$47.00	$51.00	$50.00	$54.00
0-200	500	47.00	51.00	49.00	53.00	50.00	54.00	52.00	56.00	50.00	54.00	53.00	57.00
0-100	1,080	50.00	54.00	52.00	56.00	53.00	57.00	55.00	59.00	53.00	57.00	56.00	60.00
0-50	1,900	55.00	59.00	57.00	61.00	58.00	62.00	60.00	64.00	58.00	62.00	61.00	65.00
0-20	3,000	60.00	70.00	62.00	72.00	63.00	73.00	65.00	75.00	63.00	73.00	66.00	76.00
0-10	5,000	70.00	80.00	72.00	82.00	73.00	83.00	75.00	85.00	73.00	83.00	76.00	86.00
0-5	6,700	85.00	—	87.00	—	88.00	—	90.00	—	88.00	—	91.00	—
(Intermediate and higher ranges)		(Priced	the	same	as	the	nearest	listed	meter-	relay)			
MILLIAMPERES													
0-1 to 0-50 (approx. 100 mv)	—	44.00	48.00	46.00	50.00	47.00	51.00	49.00	53.00	47.00	51.00	50.00	54.00
0-55 to 0-1000 (approx. 50 mv)	—	49.00	55.00	51.00	57.00	52.00	58.00	54.00	60.00	52.00	58.00	55.00	61.00
AMPERES†													
0-1 to 0-15 (approx. 50 mv)	—	49.00	55.00	51.00	57.00	52.00	58.00	54.00	60.00	52.00	58.00	55.00	61.00
0-16 to 0-50 (50 mv; external shunt required for DC meters.)	—	46.00	55.00	48.00	57.00	49.00	58.00	51.00	60.00	49.00	58.00	52.00	61.00
MILLIVOLTS													
0-50	50**	46.00	Min. range:	48.00	Min. range:	49.00	Min. range:	51.00	Min. range:	49.00	Min. range:	52.00	Min. range:
0-25	100	49.00	0-250 mv.	51.00	0-250 mv.	52.00	0-250 mv.	54.00	0-250 mv.	52.00	0-250 mv.	55.00	0-250 mv.
0-10	40	54.00	Any range:	56.00	Any range:	57.00	Any range:	59.00	Any range:	57.00	Any range:	60.00	Any range:
0-5	20	68.00	$65.00	70.00	$67.00	71.00	$68.00	73.00	$70.00	71.00	$68.00	74.00	$71.00
VOLTS 0-1 to 0-500 (External resistor required for ranges over 500 volts.)	Approx. 1,000 ohms per volt. Other sensitivities available.	46.00	50.00	48.00	52.00	49.00	53.00	51.00	55.00	49.00	53.00	52.00	56.00

*Resistances of DC ranges; AC resistances supplied on request.
**Supplied as standard; 100 ohms, 200 ohms, and other resistances available.
†AC milliampere and ampere ranges supplied with transformer; extra transformer required for AC ranges above 50 amperes.

Taut-Band Movements are supplied as standard in the ranges shown above in color. They can also be furnished upon specification in the higher DC ranges shown in black; add $5.00 to price listed for desired range. In these higher DC ranges the DC resistances of taut-band meters are somewhat lower than values in the Ohms column.

PRICES: CONTROLLING PYROMETERS (Taut-band standard; thermocouples not included)

TEMPERATURE RANGES		THERMO-COUPLE	MODEL PRICES FOR SINGLE SET-POINT (Add $15.00 for double)					
			502-L	503-L	602-L	603-L	1502-L	1602-L
0-3000°F.*	0-1650°C.*	Pt/13% Rh*	$56.00	$58.00	$59.00	$61.00	$59.00	$62.00
0-2500	0-1370	C/A	53.00	55.00	56.00	58.00	56.00	59.00
0-2000	0-1100	C/A	53.00	55.00	56.00	58.00	56.00	59.00
0-1500	0- 800	C/A	54.00	56.00	57.00	59.00	57.00	60.00
0-1000	0- 500	I/C	56.00	58.00	59.00	61.00	59.00	62.00
0- 750	0- 400	I/C	56.00	58.00	59.00	61.00	59.00	62.00
0- 500	0- 260	I/C	56.00	58.00	59.00	61.00	59.00	62.00
0- 300	0- 150	I/C	58.00	60.00	61.00	63.00	61.00	64.00
− 75 to +225	− 60 to +110	I/C	58.00	60.00	61.00	63.00	61.00	64.00
−200 to +100	−130 to + 40	Cu/C	58.00	60.00	61.00	63.00	61.00	64.00

*At the high temperatures at which noble metal thermocouples are used, cold-junction compensation is usually not necessary and is not furnished. If compensation is desired for a noble metal T/C, specify cold-junction compensation and add $15.00 to module price found below.

The above pyrometers are furnished as standard and are calibrated for the type of thermocouple shown. They can be calibrated for use with other thermocouples for an extra charge.
Taut-Band Movements are standard in all the ranges shown above.

OTHER MODELS: 302-L meter-relays and pyrometers are priced at $1.50 less than comparable 502-L models; 1302-L models are priced at $1.50 more than comparable 502-L models. For 303-L models, add $2.00 to prices of comparable 302-L models.

PRICES: CONTROL PACKAGES

CONTROL FUNCTIONS	SET-POINTS	FOR USE WITH METER-RELAYS				FOR USE WITH PYROMETERS			
		SEPARATE MODULE		CONTROL-PAK		SEPARATE MODULE		CONTROL-PAK	
		CAT. NO.	PRICES	CAT. NO.	PRICES	CAT. NO.	PRICES	CAT. NO.	PRICES
On-Off (Can Be Used for Latching)	Single	901-A	$55.00	902-A	$46.00	905-B	$74.00	906-B	$64.00
	Double	903-A	73.00	904-A	63.00	907-B	91.00	908-B	83.00
On-Off, time proportioning	Single	—	—	—	—	909-B	131.50		
Proportioning with SCR*	Single	911-A	85.00	912-A	76.00	915-B	104.00	916-B	95.00
3-Zone—Narrow Center Zone	Single	917-A	85.00	918-A	76.00	919-B	104.00	920-B	95.00

*SCR is external to the control circuit and normally furnished by the user.

ORDERING PROCEDURE

1. Specify model number and range from table.
2. Specify set-point arrangement. Prices above are based on single set-point, either high or low; specify which. Add $15.00 for double set-points.
3. Specify control module by model number.
4. For pyrometers, specify type of thermocouple user will furnish.
5. Specify zero position on dial:
   a. Zero left (standard).
   b. Zero right (no extra charge).
   c. Zero center (no extra charge).
   d. Zero off center (no extra charge).
   e. Zero suppressed, e.g., 25-50 volts; up to 50% of range can be suppressed (add 25% charge).

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Formerly Assembly Products, Inc.

d in U.S.A.